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LAKE STATES FOREST EXPERIMENT STATION

F O R E S T R E S E A R C H D I G E S T

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PROGRESS IN FIRE PROTECTION IN MICHIGAN

An analysis of Michigan forest fire statistics indicates that considerable progress has been made by that State in fire control. Using the percent of "C" fires, those over 10 acres, as a criterion, very definite gains in effectiveness of protection are demonstrated. In 1918, 82 percent of all fires reported were "C" fires; in 1936, only 12 percent were in this size class. This drop is due in part to incomplete data on small fires during the early years of the record. However, the trend has been consistently downward, and increasingly so during recent years, thus clearly bringing out the increased effectiveness of the protective effort.

A point of particular interest is that in 1926, a sharp and substantial increase in the percent of "B" fires occurred, along with a corresponding drop in the percent of "C" fires. In 1934, there was a large increase in "A" fires and another marked reduction in "C" fires. The relative importance of the three classes of fires has changed as shown in the table.

Size of fire	1921-25	1926-30	1931-35
	Percent of total number of fires		
A, less than 1/4 acre	6.4	11.0	15.8
B, 1/4 to 10 acres	29.6	57.4	59.7
C, over 10 acres	64.0	31.6	24.5

*Maintained in cooperation with the University of Minnesota at University Farm, St. Paul, Minnesota.

In searching for the cause of the marked changes, it was found that the 1925-26 break coincided with the reorganization of the State Conservation Department and a shift from political to technical supervision of fire control activities. The break in 1933-34 corresponds with the establishment of the CCC. It is significant that during the last three years there has been an accelerated increase in the percent of "A" fires and a corresponding decrease in the percent of both "B" and "C" fires, in spite of the fact that 1936 was an unusually bad fire year. It is believed that this is largely due to the increasing efficiency of the CCC as a protective agency. The figures for 1936 are: "C" fires, 12.1 percent; "B" fires, 58.4 percent; and "A" fires, 29.5 percent.

A QUICK, ACCURATE METHOD FOR DETERMINING THE AVERAGE SIZE OF PLANTING STOCK

The success of forest planting depends to a considerable degree upon the stock used. Comparisons of planting results upon different areas can be valid only if some rather accurate knowledge of the stock used on the different areas is available. Such knowledge can be obtained by making certain basic measurements on representative samples of the planting stock. Furthermore, where trees are graded, measurements are necessary to determine how closely the grading standards are being followed and how consistent the grading is at different times and places.

A simple, rapid, and yet accurate method for selecting the average tree for groups of planting stock is a by-product of planting tests carried out by the Lake States Forest Experiment Station on the Huron and Manistee National Forests in Michigan. By the use of this method the dimensions of the average tree for samples varying from 30 to 200+ trees can be determined by

measuring only 5 trees out of the total sample.

The method used is as follows: Arrange the trees of the sample upon a flat surface in order of size as judged ocularly, grading from the largest on one end to the smallest at the other. Then select the middle five trees. If a sample of 100 trees is used, for instance, select trees 48, 49, 50, 51, and 52. Then the average dimension of these five trees will approximate the average of the entire sample very closely; sufficiently so for all practical purposes.

The following table illustrates the remarkably close agreement between the average dimensions of the five modal trees as compared with the average obtained from measuring the entire sample. These data represent measurements of stock samples systematically selected from experimental plantings made on the Huron and Manistee National Forests.

	2-0 Red pine		1-0 Red pine		2-1 Scotch pine	
	5 modal trees	25-tree sample	5 modal trees	62-tree sample	5 modal trees	107-tree sample
Stem diameter in inches at ground line---	0.153	0.150	--	--	--	--
Top length to tip of needles inches--------	4.90	4.81	2.60	2.72	4.84	4.67
Top length to tip of bud inches--------	3.60	3.40	1.60	1.67	3.54	3.25
Root length inches--------	10.70	10.64	6.54	6.59	12.02	12.01
Top weight grams - green	2.96	2.94	0.33	0.31	2.38	2.58
Root weight grams - green	0.77	0.85	0.10	0.09	1.04	1.06
Top weight grams oven-dry------	0.90	0.89	0.18	0.19	1.12	1.18
Root weight grams oven-dry------	0.24	0.27	0.04	0.04	0.58	0.58

A word of caution may not be amiss here. Although this method makes it possible to determine the average dimensions of a given sample of stock quickly and accurately, the extent to which the average is applicable is governed by the degree to which the sample itself is representative of the stock used.

DEER DAMAGE TO JACK PINE PLANTATION IN MINNESOTA

In the spring of 1935, a plantation of 1-0 jack pine, white pine, Norway pine, and white spruce was established inside of a 5-foot, rabbit-proof enclosure on the Superior Branch of the Lake States Forest Experiment Station, Ely, Minnesota. The fence was not high enough to exclude deer and much browsing on the jack pine was noted.

On June 21, 1937, a check on the deer damage was made by Shaler E. Aldous of the biological survey. A total of 1,196 jack pine trees were examined and it was found that 874 or 73 percent of them had been browsed on by deer and only 322 or 27 percent were still undamaged. No attempt was made to record the year in which the damage was inflicted. The terminal shoots and leaders of the larger plants were browsed most severly because they were above the snow during the winters. Very few of the trees were killed by the browsing, but they were deformed and their growth retarded. Although no detailed check was made of the other species of trees in the plantation, they were browsed on much less than the jack pines. This was probably because they were smaller trees and were covered by snow in the winter. They were probably also less palatable as some of the jack pines had been browsed this summer when an abundance of choice foods were available to the deer. One deer was found within the enclosure on the day the check was made.

Not much weight can be placed upon one check of this nature but it is an indication of what might be expected at other plantations and to natural reproduction. In fact, R. K. LeBarron, in charge of the above station, says that the degree of browsing to jack pine on unfenced plantations a few miles away is much more severe than on the area checked. This problem is going to be difficult to solve as fencing is too expensive and impractical and any other methods of handling the situation are yet unknown. Jack pine is considered an important timber species in the Superior National Forest, and something will be needed to help insure its reproduction if it is going to retain its place in the forests of the future.

CHESTNUT IN UPPER MICHIGAN

In 1930, two members of the Station's staff, Joseph Kittredge and E. I. Roe, discovered a chestnut tree in the yard of an abandoned farmhouse near Ewen, Michigan.

On a recent trip in the Upper Peninsula, Roe investigated to find out if the tree was still living. It was not only living but appeared more vigorous than when first observed in 1930. It was bearing a good many burrs which were still green. The farmer's son (the house is no longer abandoned) was requested to send the Station a few of the burrs later in the fall. These proved to be mostly blind: only one nut showed anything resembling normal development. It seems doubtful that the nuts can mature at this latitude.

At present the tree measures 11.9 inches in d.b.h. (estimated at 8 inches in 1930) and 32 feet in height (estimated at 30 feet in 1930). The crown has increased considerably in size.

According to the farmer's wife, the original settler came

from Ontario, possibly the southern part where chestnut is native.

GIRDLED ASPEN GOOD FOR FUELWOOD

In converting aspen stands to coniferous forests by planting or releasing small naturally established seedlings, it is not enough to cut down the aspen trees. Aspen suckers, which, more than the large trees, are capable of smothering small conifers, must also be eliminated.

The cheapest and most effective way to prevent aspen from suckering is to girdle the trees. Aspen trees that have been "deadened" by girdling do not have the ability to send up a prolific crop of suckers like trees that have been cut down while alive. After the trees are dead they can be cut down and the wood utilized as much as possible.

Studies conducted on the Chippewa and Superior National Forests in northern Minnesota indicate that the trees begin to die about a year after girdling, and after two years most of them are dead. When the trees die, over one half of them lose their usefulness for pulpwood, excelsior, and box lumber almost immediately because of the staining of the wood. One year after the trees have died, the wood is still good for fuel although it is discolored and somewhat brittle. But after the trees have been dead 1½ to 2½ years, the lower portions of the trunks, up to a height of 15 feet, are too decayed to be good fuel and only the tops can be used.

The conclusion is that if the trees are to be utilized they should be cut as soon as the trees commence to die (and their ability to sucker has been destroyed). Within a year and one half after their death, most of them are practically a total

loss, even for fuel. In general, large trees remain sound longer than small ones. Some trees were found which seemed to have dried out before becoming infected with decay and these appeared likely to remain sound indefinitely.

INTERCEPTION OF RAINFALL BY HERBACEOUS VEGETATION

In the Forest Research Digest for February 1935, the results of tests of rainfall interception made by this Station and also some tests made by the Dominion Forest Service indicated that about 20 to 40 percent of the rainfall was intercepted by forests of various kinds.

A recent study of interception by herbaceous growth is reported in Science, Vol. 86, No. 2243, December 24, 1937. The experiments were conducted by O. R. Clark of the University of Nebraska. Using methods that permitted as close an approach as possible to actual field conditions, he tested the interception of rainfall by such species as wheat, needle grass (Stipa spartea), prairie dropseed (Sporobolus heterolepis), and little bluestem (Andropogon scoparius). Interception varied from around 45 percent to as much as 80 percent, depending upon the species and the rate of application of the water. Very little water was found to reach the ground by running down the stems.

Thus it appears that interception by herbaceous vegetation is greater even than by a hardwood forest with the leaves on the trees.

PERCENTAGE OF CULL FOR SOME HARDWOOD-HEMLOCK STANDS ON THE NICOLET AND CHEQUAMEGON NATIONAL FORESTS, WISCONSIN

During recent years the need for reliable local data on cull in standing timber in the Lake States has become more fully recognized. This has been brought about largely by the need for

accurate appraisals of stumpage in the management of working circles and administration of timber sales. To meet this need, several Forest Supervisors undertook a study of woods and mill cull on operations within their forests in 1935. The accompanying tables are the result of an analysis of 879 sample trees taken from a large logging operation on the Nicolet Forest and from several smaller operations on the Mineral Lake and Moose River ranger districts on the Chequamegon Forest.

Cull determinations were made for all trees felled for saw timber that were 50 percent or more sound. The data presented in the tables do not apply therefore to trees left standing or to unmerchantable trees felled by the sawyers. The Scribner Decimal C log rule was used in scaling, and the deductions for defect were based on the scalers' estimate of cull in the round log.

Cull percentages were determined by curving average cull over diameter at breast height and dividing the curved values by the gross volume from local volume tables based on the Scribner Decimal C log rule. For aspen two sets of cull percentages were prepared: actual cull, which was based on the volume actually rejected in the cutting operations, and theoretical cull, where only those portions of the bolts having decay were culled.

In the application of the data shown in the tables, there are two points which must be given careful consideration. First, the cull percent figures are applicable only to merchantable trees and not the total stand. Secondly, the figures are based on only a few operations, and should be applied only to similar stands within or adjacent to the working circle from which the cull data were taken. The cull percents may be of general interest to those who wish to compare them with results obtained from similar stands on other operations in the Lake States.

Table 1.- Cull percentages for three species of northern hardwoods, Chequamegon National Forest

D.b.h.	Yellow birch [1]				Sugar maple				Hemlock [2]	
	Virgin stand		Residual stand		Virgin stand		Residual stand		Virgin stand	
	Cull percent	Basis number of trees	Cull percent	Basis number of trees	Cull percent	Basis number of trees	Cull percent	Basis number of trees	Cull percent	Basis number of trees
Inches										
10	5.0	-	3.3	3	5.0	3	7.4	8	2.8	-
12	9.3	5	8.2	3	10.0	10	16.1	5	5.7	12
14	12.0	4	11.4	7	10.7	9	18.3	5	7.6	16
16	12.5	6	11.8	11	11.6	4	22.0	2	9.3	19
18	13.4	7	12.5	10	12.1	7	25.2	7	12.7	17
20	13.7	4	13.1	8	14.4	7	26.3	6	16.0	10
22	15.2	11	15.3	5	20.9	3	27.8	1	18.5	16
24	18.8	2	21.5	1	27.7	1	27.6	-	23.5	2
26	22.0	2	26.0	3	-	-	-	-	32.8	6
28	-	-	29.3	-	-	-	-	-	37.4	3
30	-	-	31.0	2	-	-	-	-	36.4	2
32	-	-	33.2	1	-	-	-	-	-	-
Basis, total number trees		41		54		44		34		103 / 276

[1] In the operations from which the data on virgin stands of yellow birch were taken, some of the smaller trees of this species were left in the stand for subsequent tie-cutting operations.

[2] In the hemlock operations many trees from 10 to 14 inches d.b.h. were left in the stand for subsequent pulpwood operations.

Table 2.- Cull percentages for some virgin stands of northern hardwoods, Nicolet National Forest, Wisconsin

D.b.h.	Hemlock		Yellow birch		Sugar maple		Basswood		Elm	
	Cull percent	Basis number of trees	Cull percent	Basis number of trees	Cull percent	Basis number of trees	Cull percent	Basis number of trees	Cull percent	Basis number of trees
Inches										
10	2.4	2	5.5	7	1.9	1	3.6	4	2.6	2
12	2.5	8	8.7	18	3.1	9	4.2	9	2.0	9
14	5.6	13	10.8	8	4.5	16	6.6	7	4.6	12
16	9.0	10	11.8	7	6.2	8	9.3	9	6.2	14
18	15.8	7	14.0	6	7.8	8	13.5	12	7.2	6
20	19.0	4	15.8	2	9.1	8	17.1	2	8.1	4
22	20.3	4	18.2	2	10.8	3	20.6	3	8.4	1
24	20.7	-	20.6	2	13.0	1	23.6	1	8.3	-
26	-	-	-	-	15.5	2	26.2	2	8.1	3
28	-	-	-	-	19.0	-	-	1	-	3
30	-	-	-	-	-	-	-	-	-	-
Basis, total number trees		48		52		56		50		54

Table 3.- Percentage of cull in one second-growth stand of aspen, Chequamegon National Forest, Wisconsin 1/

D.b.h.	Average height	Actual			Theoretical		Basis number of trees
		Gross volume cords	Net volume cords	Cull percent	Net volume cords	Cull percent	
Inches							
5	49	.04	.035	12.5	.036	10.0	4
6	52	.06	.052	13.3	.054	10.0	10
7	55	.09	.077	14.4	.081	10.0	16
8	58	.12	.101	15.8	.108	10.0	22
9	61	.14	.113	19.3	.122	12.8	15
10	63	.19	.149	21.6	.164	13.7	13
11	64	.23	.166	27.8	.190	17.4	9
12	65	.26	.166	36.1	.199	23.5	1
13	65	.30	.171	43.0	.210	30.0	3
14	66	.34	.174	48.8	.211	37.9	1
15	66	.39	.180	53.8	.218	44.1	1
16	66	.44	.180	59.1	.220	50.0	1
							96

1/Actual net volume represents the net volume of pulpwood taken out by the operations; theoretical cull is the net volume which would be utilized were only the defective portions of the tree to a 3-inch top left in the woods.

BEAVER FEEDING EXPERIMENT MINNESOTA

The amount of food consumed daily by beavers is something that is not known but the knowledge of which would be useful for purposes of beaver management and beaver farming. To obtain this information a permit was obtained from the Minnesota State Game Department to catch and confine to pens two beavers for a controlled feeding study. Three beavers were live-trapped at a dam just outside the northwest boundary of the Superior National Forest on May 28, 1937. They had been flooding the road and it was necessary that they be removed. The three animals were taken to the Portage River CCC Camp and weighed. For convenience the animals will be referred to as numbers one, two, and three. Number one, about one year old, weighed 19 pounds, 3 ounces; number two, about two or three years old, weighed 35 pounds, 1 ounce;

and number three, about two years old, weighed 29 pounds, 13 ounces. Number one was in good physical condition, but the other two had been injured in steel traps. Number two had both front feet missing but the wounds were old and well healed, while number three had only one front foot gone and the wound, although recent, was healing nicely.

Number three was released again in a lake near the Portage River Camp, and numbers one and two were taken to the Superior Branch of the Lake States Forest Experiment Station, Ely, Minnesota, and confined to pens for experimental purposes.

The sexes of the animals were not determined as it was thought they were too irritable to be handled intimately.

The pens were made 12 by 15 feet with a 4-foot, rabbit-proof fence around the sides and on the bottom. A large-sized galvanized tub was counter-sunk in each pen so that the top was level with the ground. The houses were made of lumber, 2 by 3 by 3 feet high with a tunnel-like entrance 10 inches by 1 foot along one side to offset the opening and reduce the amount of light entering the house. The tops were made removable so observations could be made, food materials removed, and bedding changed. The openings of the tunnels were placed at the edge of the tubs so the animals would have convenient access to the water.

The water in the tubs was changed daily to insure freshness and to remove all uneaten food. No attempt was made to weigh the food eaten for the first six days, while the animals were adjusting themselves to the confined condition. On June 4, accurate records of daily food consumption of each beaver were started. The method employed was to weigh the food put in one day and weigh what was uneaten the next day before more food was

added. The difference between the amount put in and that removed was the amount they consumed. An excess of food was always given so the animals would have more than they could eat.

Aspen cut into sections about 4 feet long was fed exclusively for the first 18 days. At the end of this period the animals were weighed. The small animal had lost 2 pounds, 3 ounces and the large one 5 pounds, 1 ounce. It was decided that this loss of weight was due in part to the lack of a variation in food. From that time on, a rotation of foods including aspen, alder, birch, and water plants was inaugurated.

The daily consumption of aspen up to June 21 or for 18 days' feeding averaged 21.8 ounces for the small animal and 44.6 ounces for the large one. Basing the figures on the last weights of the animals, the small one ate 1.3 ounces and the large one 1.5 ounces of aspen for each pound of their body weight. The daily consumption figures were quite regular, and the closeness of the figures based on consumption per pound of body weight indicates that the findings herein reported are accurate enough to be used until the experiment can be continued without interruption.

The small animal preferred the leaves, twigs, and bark of the smaller branches and always left the larger pieces until all else was eaten, while the larger animal preferred the larger sticks and seldom ate the leaves and twigs. This opposite preference shown by the larger animal was mostly due to the physical handicap of not having front feet with which to hold the smaller pieces of food. This animal was forced to feed wholly with the teeth and the larger sticks offered more resistance and were therefore easier to manipulate. This animal made just as neat a job of peeling the wood as the smaller one in spite of the handicap.

The experiment received a real setback on June 28 when a bear entered the pens and killed the small beaver and cut a 2-inch gash in the back of the larger one. The bear crawled over the fence into the large beaver's pen and knocked over the house, then went over the partition into the other pen and killed and ate the small beaver. A small piece of bloody beaver fur was all that remained of the small animal. Bear hair was caught on the fence where it entered and left the inclosures.

Now that this bear has tasted beaver flesh, it is expected that another visit in the near future will eliminate the other animal and temporarily stop the experiment. If this should happen, it will be futile to catch more beaver and confine them there for bear bait.

COMMERCIAL THINNING IN DENSE JACK PINE IS SUCCESSFUL

Jack pine trees often grow very densely while young. As they become older and the size of the individuals increases, many of the weaker trees die as a result of the overcrowded condition. The trees that die from this cause are wasted, since they are usually too small to have any value even for such products as pulpwood. However, if the larger trees are harvested at the right time, many of the smaller trees will live and grow to merchantable size. This principle was demonstrated by an experiment which was started in a 60-year-old stand on the Superior National Forest in 1926.

On one plot practically all of the trees over 5.5 inches in diameter (the minimum acceptable size for pulpwood trees) were removed. This cut resulted in a yield of 17 cords per acre. Only one-half cord per acre of merchantable timber was left. Thus, the owner was able to liquidate the value of the timber

property and avoid the risk of having it destroyed by fire, wind, insects, or other agencies. Ten years later, the undersized trees that had been left were found to have produced another 8.9 cords per acre. This large growth of merchantable material was mainly the result of small increases in diameter which permitted many trees to step over the line of minimum merchantable size (5.5 inches diameter).

The other plot, from which nothing was cut in 1926, grew only 5.8 cords during the following ten years, and of course the owner had to carry the entire investment for the 10-year period.

This type of cutting is useful only for stands having from about eight hundred to twelve hundred trees per acre. If there are fewer than eight or nine hundred trees per acre, the cut will be too heavy to leave sufficient trees to provide protection and growing stock. If there are more than twelve hundred per acre, the individual trees will all be so small that a good cut of merchantable material cannot be obtained.

"IT'S AN ILL WIND---"

The windstorm that swept Minnesota on January 24 and 25, 1938 was a source of annoyance to most humans and of considerable damage to the forests.

However, the deer population of the Superior National Forest benefited materially from the thousands of trees that were broken off or uprooted and the many twigs and branches whipped off by the wind. Actually the loss to the forest was not great when prorated over the entire area, especially as the bulk of the damage was to already defective trees. On the other hand, the gain to the deer in the form of browse was considerable.

In some of the deer yards examined two days after the

storm, the snow was green in spots with needles of balsam and spruce and fronds of white cedar. Area after area could be found where the deer were picking up this readily obtainable food. Some of the larger branches and broken trees were being browsed but the deer had not yet found all of them. There is no question but that the food made available by this one storm will be worth much in cash saving to the State. The equivalent in food value of alfalfa distributed to the animals or in labor used for lopping off branches would cost the State several thousand dollars. Moreover, the distribution of food by artificial means would cover only a fraction of that accomplished by the wind.

Up until February 1, 1938 the snowfall in the northern part of Minnesota had not been excessive, and the relatively mild temperatures, in conjunction with the abundant food supply made available by the high winds, should enable deer to come through the present season in good condition.

TIP MOTH ATTACKS

During 1937 it was observed that tip moth damage was unusually abundant in eastern lower Michigan. In fact it was even discovered while examining for potential cone crops that many branch tips on middle-aged to mature red pines had been killed back by these insects.

Some conception of the degree of attack on planted trees is afforded by data collected in late August 1937 on a plantation of red pine planted in the fall of 1934 at Roscommon, Michigan. These data showed that 42 percent of the trees alive at the beginning of the year had been attacked by the tip moth. Although these attacks are not commonly causes of death for young planted trees, they do reduce growth and cannot but adversely affect the

vigor of the tree attacked. This examination showed that of the trees classed as growing, 30 percent had been attacked, while 60 percent of the living, 20 percent of the failing, and 13 percent of the dead trees had been so attacked.